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METALS AND ALLOYS

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(See 1473)

METALS AND ALLOYS

Direct Gold

Direct filling gold is supplied in three forms: foil, crystalline or mat, and powdered or sintered. Pure gold, regardless of form, can be cold welded to itself by the application of force. The materials, therefore, can be used interchangeably within the same cavity. To maintain cohesiveness, all direct filling golds must be kept free from contaminants such as saliva, moisture and odors from the breath.

The handling characteristics of gold foil, mat gold and powdered gold differ somewhat. The high mass per unit volume and spreading quality of powdered gold facilitate speeding up the condensation of the restoration.[1-4]

The three forms of pure gold, when properly condensed, appear to possess comparable strength, hardness, density and abrasion resistance.[5-8] Unlike cast gold, direct filling gold is relatively soft and weak. Therefore, the use of compacted gold should be limited to areas where it can "fill" rather than reconstruct.

GOLD CASTING ALLOY

Gold casting alloys are used extensively for the fixed restoration of severely damaged and missing teeth and to a lesser degree for the fabrication of removable partial dentures.

The golds are classified according to their hardness as determined by their resistance to identation. The alloys fall into four

groups: soft (Type I Inlay Gold) medium (Type II Inlay Gold), hard (Type III Crown-and-Bridge Gold), and extra hard (Type IV Partial Denture Gold). Hardness is used to classify the types because, in general, other mechanical properties correlate with hardness.

For most practical purposes a satisfactory gold casting alloy can be defined mechanically by its values for hardness and elongation. The relationship between hardness and elongation is much less definite than the relationship between hardness and elastic limit, or between hardness and tensile strength. In general, however, the soft alloys exhibit higher elongation than the hard alloys, as might be expected. The classification makes possible the rational selection of alloys on the basis of properties in relation to functional requirements imposed by the clinical situation.

The ranges in composition of the four types of gold casting alloys are given in Table ___.

Table ___ Range of Percentage Composition of Dental Casting Gold Alloy

	Component					
Type of alloy	Gold	Silver	Copper	Palladium	Platinum	Zinc
I	80.2-95.8	2.4-12.0	1.6- 6.2	0.0- 3.6	0.0-1.0	0.0-1.2
II	73.0-83.0	6.9-14.5	5.8-10.5	0.0- 5.6	0.0-4.2	0.0-1.4
III	71.0-79.8	5.2-13.4	7.1-12.6	0.0- 6.5	0.0-7.5	0.0-2.0
IV	62.4-71.9	8.0-17.4	8.6-15.4	0.0-10.1	0.2-8.2	0.0-2.7

The minimum requirement for gold and metals of the platinum group varies from 83% for the soft alloys, Type I, to 75% for the extra hard alloys, Type IV. More base metal is required in the hard alloys but

the noble metal content is kept high enough to give tarnish and corrosion resistance.[9]

The properties of fine grain alloys are superior to those of coarse grain materials.[10,11] Grain refinement increases tensile strength and elongation by about 30 percent. A hundredfold increase in the number of grains per unit volume may be obtained by the addition of approximately 50 ppm of ruthenium or iridium.

Many of the dental gold alloys can be hardened by appropriate heat treatment. The alloys that contain large amounts of gold and metals of the platinum group (Type I and II) have a low hardness and respond very little to heat treatment. Hard and extra hard alloys (Types III and IV) can be softened by quenching after holding at about 700C (1,292F) for ten minutes. Subsequent hardening is attained by cooling uniformly from 450C to 250C (842F to 482F) in 30 minutes. Greater strength and hardness will be developed under this treatment, but with a consequent loss in ductility. In the softening and hardening of any specific alloy, the recommendation of the manufacturer should be followed.

The mechanism of hardening in dental gold alloy has been found to be an order-disorder reaction and the precipitation of a silver rich phase.[12]

Reported values for the linear shrinkage of gold and its alloys range from 1.0 to almost 2.2%.[13-18] The reason for the relatively large spread in values may be the variation in size and shape of the specimen upon which shrinkage was measured, the composition of the alloys and the casting technique. No single value, therefore, can be given for the casting

shrinkage of gold and its alloys unless these three variables are precisely defined; then the determined linear shrinkage would apply to those precisely controlled conditions only. However, a value of 1.4±0.2% is considered to be satisfactory for practical castings.

Certified Dental Casting Gold Alloys

ADA Specification No. 5

Type I, Soft

Vickers Hardness Number 50-90

Aderer "A" Soft, J. Aderer, Inc.

Baker Inlay Soft, Baker Dental Dept. of Engelhard Industries, Engelhard Minerals & Chemicals Corp.

Codesco Premium, Codesco, Inc.

Crown K Inlay; No. 2 Inlay, General Refineries, Inc.

Deeone, Howmedica, Inc., Dental Div.

Goldsmith I Inlay, D. F. Goldsmith Chemicals & Metals Corp.

Jelenko Special Inlay, J. F. Jelenko & Co., Pennwalt Corp.

Leff Light Inlay, Leff Dental Golds

Mowrey S-1; S-M; 22K, W. E. Mowrey Co.

Ney-Oro A-A, J. M. Ney Co.

Noble 1, Noble Metals & Alloys Co., Inc.

Rx Jeneric A, Rx Jeneric Gold Co., Inc.

Sterngold S, Sterndent Corp.

Veribest 22 Kt Inlay, A. Szabo Co., Inc.

Wilkinson 2S, Wilkinson Co.

Williams Harmony Line Soft, Williams Gold Refining Co., Inc.

Type II, Medium
Vickers Hardness Number 90-120

Aderer "B" Medium, J. Aderer, Inc.

Aleco No. 1; No. 2, A. L. Engelhardt Co., a subsidiary of Howmedica, Inc.

American Gold "M" Inlay Medium, American Gold Co.

American Gold "M-H" Inlay, American Gold Co.

Austenal No. 2, Howmedica, Inc., Dental Div.

Baker Inlay Medium, Baker Dental Dept. of Engelhard Industries, Engelhard Minerals & Chemicals Corp.

Codesco Premium, Codesco, Inc.

Crown No. 1; Knapp No. 2; T, General Refineries, Inc.

Deetwo, Howmedica, Inc., Dental Div.

Dent Gold No. 1, A. Szabo Co., Inc.

Inlay II B, Direct Dental Sales & Supplies, Inc.

Jelenko Modulay; Platincast; 820 Medium Hard, J. F. Jelenko & Co., Pennwalt Corp.

Leff Medium Soft, Leff Dental Golds

Libra II Inlay and Crown, Libra Gold Co.

Mowrey B Inlay; No. 91; S-2; T, W. E. Mowrey Co.

Noble 2, Noble Metals & Alloys Co., Inc.

Rx Jeneric B, Rx Jeneric Gold Co., Inc.

Sterngold 1, Sterndent Corp.

Ticonium TG2, Ticonium Co.

Wilkinson 8M; 76, Wilkinson Co.

Williams Harmony Line Medium, Williams Gold Refining Co., Inc.

Type III, Hard
Vickers Hardness Number 120-150

Aderer "C" Bridge; Dressel, J. Aderer, Inc.

Aleco No. 4; No. 5, A. L. Engelhardt Co., a subsidiary of Howmedica, Inc.

American Gold "B" Bridge, American Gold Co.

American Gold "T" Bridge Hard, American Gold Co.

Austenal No. 5, Howmedica, Inc., Dental Div.

Baker Inlay Hard, Baker Dental Dept. of Engelhard Industries, Engelhard Minerals & Chemicals Corp.

Bridge III-C, Direct Dental Sales & Supplies, Inc.

Codesco Premium, Codesco, Inc.

Crown Kanpp No. 3; No. 9; Supreme; TT, General Refineries, Inc.

Deesix, Howmedica, Inc., Dental Div.

Dent Gold No. 2, A. Szabo Co., Inc.

Jelenko Durocast; Firmilay; J-9; No. 13, J. F. Jelenko & Co., Pennwalt, Corp.

Leff "C", Leff Dental Golds

Libra III Crown and Bridge, Libra Gold Co.

Mowrey 120; S-3; Special Inlays; TT, W. E. Mowrey Co.

Ney-Oro B-2, J. M. Ney Co.

Noble 3, Noble Metals & Alloys Co., Inc.

Rx Jeneric C, Rx Jeneric Gold Co., Inc.

Speyer No. 18; No. 21, Speyer Smelting & Refining Co.

Sterngold 2; Sterngold Inlay; Sterngold B; Sterngold Bridgette Inlay; Sterngold 5, Sterndent Corp.

Ticonium TG3, Ticonium Co.

Wilkinson 9M, Wilkinson Co.

Williams Harmony Line Hard; "Klondiker," Williams Gold Refining Co., Inc.

Type IV, Extra Hard
Vickers Hardness Number
Quenched, Minimum 150;
Hardened, Minimum 220

Aderer No. 3 Bridge Gold; Procast Gold, J. Aderer, Inc.

Aleco No. 9, A. L. Engelhardt Co., a subsidiary of Howmedica, Inc.

American Gold "C" Partial Extra Hard, American Gold Co.

Baker Inlay Extra Hard, Baker Dental Dept. of Engelhard Industries, Engelhard Minerals & Chemicals Corp.

Bridge Partial IV D, Direct Dental Sales & Supplies, Inc.

Codesco Premium Type IV, Codesco, Inc.

Dee-Eighteen, Howmedica, Inc., Dental Div.

Jelenko No. 7; J-13, J. F. Jelenko & Co., Pennwalt Corp.

Leff Hard, Leff Dental Golds

Libra IV Extra Hard, Libra Gold Co.

Mowrey No. 8; Par-Cast, W. E. Mowrey Co.

Ney-Oro G-3, J. M. Ney Co.

Noble 4; 18; 19, Noble Metals & Alloys Co., Inc.

Rx Jeneric IV, Rx Jeneric Gold Co., Inc.

Sterngold 3; Sterngold Supercast, Sterndent Corp.

Ticonium TG4, Ticonium Co.

Williams Harmony Line Extra Hard, Williams Gold Refining Co., Inc.

Porcelain to Metal Systems

The fusion of porcelains to metals is an ancient art. However, only since the early 1950's has the fusing of glasslike substances to cast fixed restorations been of interest to the dental profession. The following problems initially encumbered the production of porcelain-

metal dental restorations: fused porcelain displayed cracks after firing because of the mismatch of thermal expansion between the porcelain and the metal substructure, color of the fused porcelain was altered adversely by color-forming oxides and by technique, and separation of the porcelain-metal couple occurred upon the flexure of appliances cast from soft gold-based alloys.

Over the past two decades, the foregoing difficulties have been reduced in occurrence and severity.[19,20] Development of improved porcelain-alloy systems has enhanced both the usefulness and the status of the porcelain-fused-to-metal restoration. With skillful handling, these systems yield esthetically pleasing restorations that can withstand the stresses of mastication.

High Gold

"High gold" is a term applicable to high-fusing crown-and-bridge alloys, the gold content of which exceeds 85% by weight. These alloys contain sufficient palladium (about 6%) and platinum (about 4%) to insure that their fusion temperature range is higher than the fusion temperatures of dental porcelains. The high golds contain relatively small quantities of silver, iron, indium and tin.[21]

High gold alloys exhibit a subdued yellow hue. Strength and hardness values of the cast materials are within the range of type III casting golds, whereas elongation is within the range of hardened Type IV golds and chromium-containing partial denture casting alloys.[21] Porcelain to metal bond strength is adequate.[22-26]

Hardening of high gold castings occurs during the porcelain firing procedure.[21,27-29] The aging mechanism appears to involve the transformation of an iron-platinum intermetallic compound (FePt) that forms during

solidification or at temperatures just below the solidus to $FePt_3$ at temperatures below 982C. It is likely that indium and tin influence to some extent the effects of the $FePt_3$ precipitate. The principal functions of indium and tin, however, are probably other than hardening or strengthening. Among such functions are perhaps grain refinement, control of the coefficient of thermal expansion and improvement of the porcelain-to-metal bond.

Low Gold

Light-colored precious-metal crown-and-bridge alloys have been available for several years.[30,31] High fusion temperature ranges, low ductility and questionable tarnish resistance have discouraged the routine use of these materials in fixed prosthodontic procedures. Recently, however, seemingly new "white golds" or "low golds" have attracted increased attention as potential substitutes for the more costly yellow alloys.[32] Several white golds intended primarily for use in the ceramic-metal technique have appeared on the commercial market.

The gold content of low gold systems varies from a minimum of about 20% by weight to a maximum of 60% by weight. Gold content of most available products is approximately 50%. Sufficient palladium is used in production of the alloys to raise the total noble metal content to at least 80%. The majority of low gold alloys contain silver which contributes to their whiteness. Minor quantities of base metals such as indium, tin, nickel and gallium play a significant role in the development of hardness and strength.[33,34]

Strength characteristics of the low gold alloys are comparable to those of hardened Type III casting golds. These materials, however, are harder and less ductile than conventional crown-and-bridge alloys,[33,34] Porcelain to metal bond strength is adequate.[25,26]

Palladium-Silver

The use of veneerable alloys containing substantial amounts of palladium (22% to 50% by weight) and silver (35% to 65% by weight) has increased in recent years. The palladium-silver based crown-and-bridge alloys contain very little or no gold.[32,34,36] Although the nobility of palladium is lower than that of platinum, the preference for palladium as a major component of these alloys is due probably to the lower melting point, lower cost per unit weight, and lower density of palladium.

The palladium-silver alloys used for fabrication of porcelain-fused-to-metal restorations contain minor amounts of low melting base metals such as zinc, indium or tin. These components increase the fluidity of the molten alloy and thereby improve its castability. Indium and tin also form intermetallic compounds with both palladium and silver. Age hardening of certain alloys appears to be related to the formation of these compounds.

From manufacturers' data and from limited independent laboratory investigation it seems that the strength characteristics of the palladium-silver based materials are comparable to those of hardened Type III casting golds.[34-36] These alloys, however, are significantly harder and less ductile than Type III golds. The degree of bonding of porcelains to the alloys appears to be adequate.[25,26]

The successful fabrication of fixed prostheses from the palladium-silver alloys requires strict adherence to meticulous laboratory technique. The alloys, in the molten state, readily occlude and interact with atmospheric gases. The entrapment of gases may result in the production of porous castings. The casting of multiple components, therefore, requires the use of a well designed sprue arrangement that provides adequate reservoirs and vents. The use of borax (reducing) flux is generally recommended to prevent excessive oxidation of the alloys during the fusion. However, so that possible contamination of the metal can be avoided, a flux should not be used when the castings are to be veneered with porcelain. The alloys are attacked vigorously by mineral acids. Therefore, the removal of investment debris and cleaning of the cast pieces must be accomplished by liquid-honing or sandblasting.

In the use of palladium-silver alloys, certain specific points must be considered. Alloys with less than 50% palladium may tarnish in the oral environment, although their mechanical properties

may be completely adequate to meet the requirement of long-term function. When porcelain is fired to alloys containing silver in excess of 8% to 10%, a yellowish green discoloration of the porcelain may occur during the firing operation. This difficulty may be precluded by application of a suitable colloidal gold coating agent to the metal substructure.

Since sufficient data based on long-term observations of fixed prostheses fabricated from palladium-silver based alloys are not available, the clinical efficacy of these materials cannot be ascertained. It appears, therefore, that caution and conservation should be exercised in their present use.

Base Metal

Since the late 1960's, more than 20 relatively inexpensive base metal alloys have been marketed for use in the porcelain-fused-to-metal technique. Compositional features of these materials reflect obvious as well as subtle departures from the compositions of base metal partial denture alloys.[37-39] Nickel (about 60% to 80% by weight) and chromium (about 12% to 20% by weight) are the major constituents of most available products. At least one alloy is based on an iron (about 55% by weight)-chromium (about 27% by weight) system.

Modification of the nickel-chromium system by addition of varying amounts of minor alloying elements such as carbon, molybdenum, aluminum, manganese, tungsten, niobium, tantalum, boron, silicon and beryllium has made possible the availability of a broad selection of castable alloys, the structural features and properties of which are significantly diverse. Therefore, each base metal restorative alloy must be

considered as a unique entity. Conclusions based on experience with one material cannot be used to predict the behavior of another.

The base metal crown-and-bridge alloys are platinum colored, lightweight and possess little or no scrap value.

Available base metal alloys offer broad ranges of hardness and strength.[40] Most base metal alloys, however, are harder and stronger than precious metal crown-and-bridge alloys. Generally, the Vickers hardness of the base metal alloys is about twice that of precious metal-porcelain alloys. Ultimate tensile strength and yield strength have ranges of 552 to 1,024 MN/m^2 (80,000 to 150,000 psi) and 221 to 759 MN/m^2 (32,000 to 110,000 psi), respectively. Modulus of elasticity values are close to 207×10^3 MN/m^2 (30 million psi). Elongation of most materials is relatively low (2% to 10%). At temperatures employed in porcelain veneering the sag resistance of the base metals is greater than that of high-fusing precious alloys.[41]

High modulus of elasticity (rigidity) and high yield strength (resistance to permanent deformation) suggest the potential usefulness of the base metal alloys for the casting of thin copings and retainers, as well as for the fabrication of long-span fixed partial dentures. These properties, however, when coupled with low ductility and high hardness, impede finishing and adaptation of margins. High hardness also complicates the adjustment of proximal contact areas and occlusal equilibration.

The application of porcelain to the base metal crown-and-bridge alloys is a sensitive technique. Success of the procedure depends on

meticulous surface preparation of the substrate castings. Evaluation of the apparent bond strength of various base metal-porcelain combinations has shown that some values are significantly higher and others significantly lower than the bond strength of precious alloy-porcelain systems.[25,40,42] Excessive oxides which acrue at the surface of some base metal alloys during porcelain firing appear to preclude adequate porcelain-to-metal bonding.[42,43]

Some base metal crown-and-bridge alloys have higher _in vitro_ corrosion rates than dental casting golds.[44] The clinical significance of this finding is not known. Additionally, sufficient research relevant to determination of the long term compatibility of fixed base metal prostheses with tissues of the human host is lacking.

Alloys that contain beryllium may be hazardous to laboratory workers.[40] Berylliosis, a condition characterized by the formation of granulomas of the lung, and more rarely of the skin, lymph nodes and liver, may result from exposure to the element during melting and grinding of beryllium containing alloys. Inhalation of fumes and dusts of beryllium and its compounds is the major route of exposure. Although no instances of beryllium toxicity in dentistry have been reported, dental industry has tended to move toward the manufacture of beryllium free materials.

The most perplexing problems associated with the use of available base metal crown-and-bridge alloys are difficulties encountered in the casting of these materials using procedures, investments and equipment designed for the centrifugal casting of gold alloys. Thin

sections of base metal castings often are incomplete. Fine detail of margins is prone to obliteration by rounding. Extracoronally retained castings made for preparations with relatively parallel walls (<5° taper) often fail to seat completely.[38] Critical attention to individual technique differences is required to reduce the frequency of occurrence of these problems.[40]

Base Metal Alloys

Alloys of base metals are the principal materials from which removable partial dentures are fabricated. They are used to a lesser extent, for the construction of full denture bases, implants and tooth-borne surgical and periodontal splints.

Most base metal partial denture alloys do not contain precious or noble elements. The alloys must, by the composition requirement of American Dental Association Specification No. 14, contain a total of not less than 85 percent by weight of chromium, cobalt and nickel. Passivation of alloys meeting the requirement is sufficient to provide reasonable assurance of corrosion resistance. Cobalt (around 60%) and chromium (25% to 30%) are the major constituents of most available products. Molybdenum, carbon and tungsten are principal strengthening elements. The alloys may also contain minor additions of iron, manganese, tantalum, platinum, niobium, gallium, copper, iron, carbon and silicon.[45,46]

One alloy acceptable for use in partial denture prostheses is formulated on a nickel (about 70%)-chromium (about 16%) system. This material contains relatively little cobalt. Important minor components of the nickel-chromium alloy include aluminum (about 2.5%)

and beryllium (about 0.5%). Aluminum and nickel form a gamma prime (γ') phase on cooling of the alloys from their solidus to room temperature. Presumably, γ' is an intermetallic compound based on the formula Ni_3Al. Precipitation of γ' plays a prominent role in the strengthening and hardening of the nickel-chromium alloy.[47] Beryllium lowers the melting temperature range and improves grain structure.

Some physical characteristics of the base metal alloys differ markedly from those of partial denture golds.[48,52] Comparatively, base metal alloys exhibit higher melting temperatures, greater casting shrinkage and lower density. Polished prosthetic devices cast from base metals are lustrous and silver white.

Base metal partial denture alloys are about 30 percent harder than Type IV golds. Typical Rockwell (R-30N) hardness values range between 50 and 60. Appliances cast from alloys exhibiting such hardness must be finished and polished with special laboratory equipment.

Ultimate tensile strengths of the base metal alloys range from 620 to 830 MN/m^2 (90,000 to 120,000 psi). These values fall within the range of tensile strength values exhibited by partial denture golds. Similarly, yield strengths of the nonprecious alloys lie between 414 and 620 MN/m^2 (60,000 and 90,000 psi) and are comparable to the yield strengths of Type IV golds. When comparing yield strengths of base metals with those of golds, the amount of "offset" (0.1 or 0.2%) used in analysis of stress-strain diagrams or load tracings must be the same for both types of materials. Use of a 0.2% offset in the testing of base metal alloys is common. The resulting values may be as much as 10 percent higher than those obtained with a 0.1% offset.

Rigidity of cast base metal partial denture alloys is approximately twice that of cast dental golds. Therefore, under a given load within its elastic limit, a structure cast from a base metal alloy will be deflected only half as much as a like structure made from gold alloy. Modulus of elasticity values of cobalt-chromium and nickel-chromium partial denture alloys approach 207 $X10^3$ MN/m^2 (30 million psi).

Base metal alloys tend to be brittle rather than ductile. Factors such as melting procedure, casting temperature and mold conditions affect microstructure, which, in turn, influence elongation.[53,54] Available base metal partial denture alloys exhibit "as-cast" elongation values of 2 to 10 percent.

The mechanical properties of cobalt-chromium partial denture alloys can be neither improved nor controlled by heat treatment. Properties of some nickel-chromium based materials, however, can be altered by high temperature treatment. For heat treatable materials, a softening treatment (15 minutes at 982C followed by water quenching) may be used to improve workability. Subsequent rehardening (15 minutes at 704C followed by water quenching) will increase toughness of cast appliances.[55-57]

Chromium containing alloys are attacked chlorine. Household bleaches should not be used to cleanse removable appliances made from base metal alloys.

Allergic responses to the constituents of base metal alloys are observed occasionally. However, most adverse tissue reactions attributed to the wearing of a base metal prosthesis are manifestations of improper design or poor fit.

Certified Dental Cast Chromium-Containing Alloys

ADA Specification No. 14

Type I, High Fusing

Alloy X-12, Federal Prosthetics, Inc.

Dentorium, Dentorium Products Co., Inc.

JD Alloy; LG Alloy, J. F. Jelenko & Co., Pennwalt Corp.

Niranium, Niranium Corp.

Nobilium Alloy, Nobilium Products, Inc.

Platinore, Allen Dynamics, Inc.

Regalloy, Ransom & Randolph Co., Div. of Dentsply International, Inc.

Stalite Chromium-Cobalt Alloy "S" Ingots, Buffalo Dental Mfg., Co., Inc.

Ticonium Premium 100, Ticonium Co.

Vitallium, Howmedica, Inc., Dental Div.

Vitallium^2, Howmedica, Inc., Dental Div.

Wironium, Williams Gold Refining Co., Inc.

Type II, Low Fusing

Ticonium No. 50, Ticonium Co.

Wrought Wire

The usefulness of wrought wire in the construction of clasps and orthodontic appliances is derived mainly from its ability to transmit, store and resist forces.

Precious alloys used in the manufacture of wire are complex materials containing gold, platinum, copper, palladium, silver, zinc, and occasionally nickel.[58] The specification for wrought gold wire alloys prescribes two grades of wire. One grade has a high precious metal content and is a white-colored wire, designated as Type I; the second

grade has a low precious metal content and is a gold-colored wire, designated as Type II. The range in composition of Type I and Type II alloys is given in Table ___.

Type I wire that complies with the specification requirement for composition will contain not less than 75% gold and metals of the platinum group. The gold colored wire (Type II) must contain no less than 65% gold and metals of the platinum group.

Table ___ Range of Percentage Composition of Wrought Gold Wire Alloys

Type of alloy	Component						
	Gold	Silver	Copper	Palladium	Platinum	Zinc	Nickel
I	53.6-63.2	8.5-12.4	10.2-15.2	0.0- 8.2	6.8-17.6	0.0-0.6	0.0-1.9
II	60.0-67.1	8.4-21.4	10.2-19.6	0.0-10.3	0.0- 6.5	0.0-1.7	0.0-6.2

Gold alloy wires obtain their properties from their composition and from their wrought structure. Pertinent physical properties of Type II wire are significantly lower than those of Type I. Nonetheless, the less expensive gold colored wire is used more frequently than the white gold wire.

Most gold wires, as supplied by the manufacturer, are annealed and normally do not require further annealing during fabrication. If, during processing, severe bending is necessary, then additional annealing may be required. The manufacturer's recommended annealing temperature should be followed. Care should be taken not to overheat the wire as overheating may destroy the wrought structure, thereby significantly reducing the properties of the wire.

Many wrought gold wires can be age hardened. The manufacturer's recommendation of temperature and time should be followed to obtain the best combination of high hardness, strength and ductility that can be developed in the alloy.

Less expensive wrought stainless steels, nickel-chromium alloys and cobalt-chromium alloys have largely displaced the gold-based alloys in orthodontics. Excellent tarnish and corrosion resistance exhibited by the base metal wires is imparted principally by chromium.

Certified Dental Wrought Gold Wire Alloy

ADA Specification No. 7

Type I, High Precious Metal

Aderer No. 20 Clasp; No. 4, J. Aderer, Inc.

Crown Hylastic, General Refineries, Inc.

Deepep-Hard, Howmedica, Inc., Dental Div.

Jelenko Super Wire, J. F. Jelenko & Co., Pennwalt Corp.

Mowrey 12% Wire, W. E. Mowrey Co.

Ney-Oro Elastic No. 4, J. M. Ney Co.

Williams No. 2, Williams Gold Refining Co., Inc.

Type II, Low Precious Metal

Aderer No. 16; No. 18 Clasp, J. Aderer, Inc.

Mowrey No. 1 Wire, W. E. Mowrey Co.

Ney Gold Color Elastic, J. M. Ney Co.

Sterngold G-43, Sterndent Corp.

Williams No. 4; No. 70, Williams Gold Refining Co., Inc.

Performed Crowns

For the most part, preformed metal crowns are used for the fabrication of interim restorations. When properly fitted and contoured, these devices restore prepared and damaged teeth to function and assist in the maintenance of the integrity of soft and hard supporting tissues.

Aluminum

Anatomic as well as nonanatomic preformed aluminum crowns are available from commercial sources. Softness of the metal facilitates trimming, contouring and festooning, but limits service life. The cosmetic features of aluminum are poor. Therefore, their use should be restricted to the posterior areas of the mouth.

Gold Shell

Burnishable gold shells are intended primarily for the fabrication of permanent full coverage restorations. Crowns made from gold shells are less durable, less accurate, and less esthetic than crowns cast from gold alloys. The relatively high cost of gold shells contraindicates their use as temporary restorations.

Stainless Steel

Preformed crowns are made from both hard and soft stainless ferrous alloys. The properly contoured and adapted hard steel crown makes an excellent restoration for severely damaged deciduous teeth. Corrosion resistance of the hard alloy appears adequate. Soft stainless steel crowns are used mainly for the fabrication of interim restorations.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) 6 Metals and Alloys,		5. TYPE OF REPORT & PERIOD COVERED Manuscript
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) 10 Eugene F. Huget, LTC, DC		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Institute of Dental Research Walter Reed Army Medical Center Washington, D.C. 20012		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Not applicable
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Medical Research and Development Command ATTN: (SGRD-RP) Washington, D.C. 20314		11 12. REPORT DATE 17 Nov[redacted]77
		13. NUMBER OF PAGES 28 12 29p.
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Unlimited

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Base metal alloys, dental restorative materials, gold, palladium-silver alloys.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report describes the generic derivation and the properties of precious and nonprecious metals and alloys used in dental practice. Limitations of the clinical application of the subject materials are pointed out.

038670

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